

DESIGN &
ENGINEERING
SERVICES



**The Refrigeration
Technology and
Test Center (RTTC)**

“After labor and rent, utilities represent the largest controllable expense in a supermarket. With Edison’s help, Vons hopes to create a comfortable environment for our customers while providing a cost-effective and energy-efficient supermarket operation.”

Geoff Edwards
Vons Manager of
Construction



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REFRIGERATED DISPLAY CASE PERFORMANCE EVALUATION

For supermarkets, refrigeration accounts for about 50% of the annual electric energy bill. In a typical store, the compressors serving medium temperature display cases can represent up to 20% of the electric costs. Southern California Edison’s Refrigeration Technology and Test Center (RTTC) undertook a study to assess the critical operating parameters that impact the energy use of the typical, open, multi-deck, medium temperature display case.

With this study, Edison’s customers can understand factors that will contribute to the reduction of their electric energy costs.

The RTTC’s research on refrigeration helps our customers make informed purchasing and operating decisions and assists them in remaining competitive and abreast of changes in refrigeration technology. This is one of the many services Edison offers as a leader in energy efficiency and environmental issues.



**The medium
temperature,
multi-deck
display case is
the primary
storage system
for dairy, deli,
fresh meat,
produce and
poultry.**

THE OPERATION OF MEDIUM-TEMPERATURE DISPLAY CASES IS IMPACTED BY A VARIETY OF FACTORS

The RTTC’s study of display cases evaluated the performance and energy use of a 20-foot-long, medium temperature fixture, by varying the following conditions:

- Indoor relative humidity
- Indoor dry bulb temperature
- Air curtain agitation representing shoppers adjacent to the case
- Fan motor efficiency
- Product loading arrangement

- 75° dry bulb temperature, 55% relative humidity
- 78° dry bulb temperature, 60% relative humidity
- 75° dry bulb temperature, 40% relative humidity
- 70° dry bulb temperature, 40% relative humidity
- 70° dry bulb temperature, 65% relative humidity

Impact of Indoor Temperature and Indoor Relative Humidity

To assess the impact of indoor temperature and indoor relative humidity on the operation of the typical display case, a series of tests were conducted. The tests were run under five indoor conditions, with periodic disruption of the air curtain to simulate the effect of shoppers. The scenarios, which mimicked typical and some extreme indoor store conditions, were:

The case refrigeration load and compressor power use increased in direct proportion to the increase in the interior dry bulb temperature, with approximately a 1% increase in compressor power use per 1°F increase in indoor temperature. However, a 10°F increase in indoor wet bulb temperature (which reflects an increase in relative humidity) resulted in a 25% increase in the compressor power use.

In other words, compressor power use increased at a much faster rate as the relative humidity increased, than it did as the indoor dry bulb temperature increased. The case refrigeration load was affected in a similar manner by the same interior test conditions.



FOR MORE INFORMATION

on this study and other energy efficiency concerns relating to supermarket refrigeration, contact: The Refrigeration Technology and Test Center at (626) 812-7660, or visit www.sce.com



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The indoor relative humidity had, by far, the biggest impact on the energy performance of the display case.

Impact of Air Curtain Agitation

The agitation of the display case air curtain resulted in:

- 1/2°F increase in the temperature of the air curtain at its discharge point
- 3°F increase in the mid-height air curtain temperature which would increase the infiltration load of the case
- 870 Btu/hr increase in the refrigeration load of the case

While air curtain interruption is an inevitable fact in a supermarket, it is important to understand its impact on the operation of the display case.

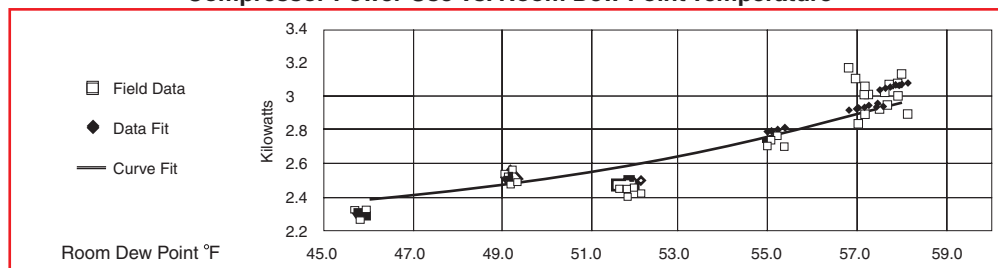
Impact of Fan Motor Efficiency

The fan motor test included three types of motors:

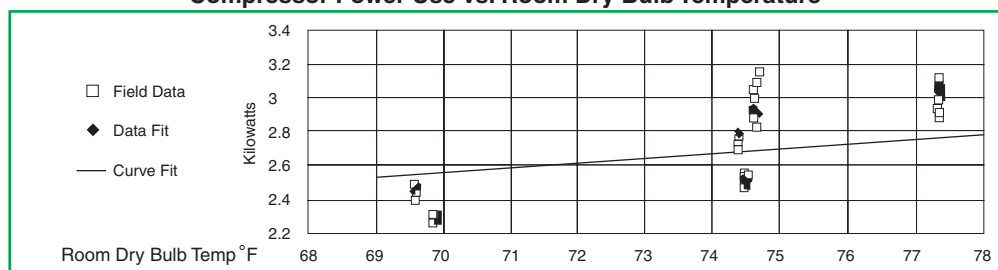
1. Shaded Pole Motor, the standard fan motor type
2. Permanent Split Capacitor Motor (PSC), typically more efficient than #1
3. Electronically Commutated Motor (ECM), typically the most efficient

In general, the energy-efficient motors dissipated less heat into the refrigerated display cases and improved the case cooling capacity. The efficient motors also consumed less electric power. The test results indicated a power savings of 24% from the PSC motors and 47% from the ECM motors, compared to the shaded pole motor, at 75°F interior dry bulb temperature and 55% relative humidity.

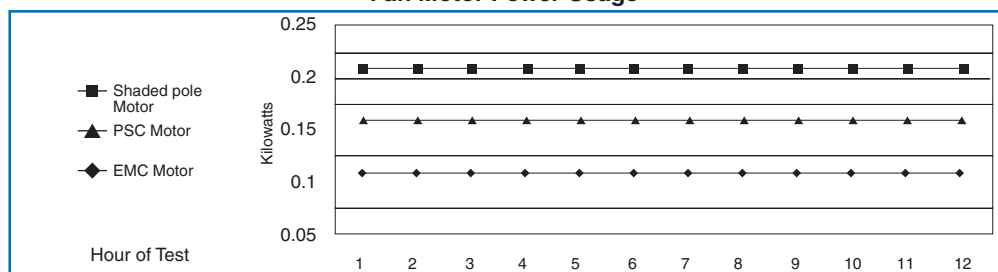
Compressor Power Use vs. Room Dew Point Temperature



Compressor Power Use vs. Room Dry Bulb Temperature



Fan Motor Power Usage



Impact of Product Loading Arrangements

The RTTC compared an ideal product loading of the case with the more common "non-uniform" loading seen in supermarkets. This evaluation was also carried out at 75°F interior dry bulb temperature and 55% relative humidity, with on-going air curtain agitation. In the "real-life" test scenario, shelves were over-filled, gaps left in other shelves, and the return air flow at the bottom of the case was partially blocked by products. In this instance, the product core temperature on the top shelf increased by 2°F, and product temperature on the bottom shelf increased by 1/2°F, demonstrating that goods at the top of the case are more vulnerable to the impacts of "non-uniform" product loading.

Conclusions

This study demonstrates to Edison's supermarket customers the need to monitor indoor relative humidity to reduce energy use. In addition, efficient motors in the display cases could cut fan energy use almost in half. Also, while irregular case loading did not impact energy use, it can adversely affect the temperature of the products and their shelf life. Other studies indicate a 5°F increase in product temperature can reduce shelf life by four days. Each of these conclusions has cost implications and needs to be carefully evaluated by our supermarket customers.